Apparel Care and the Environment

Alternative Technologies and Labeling

Session I

Welcome and Introduction

William H. Sanders

Director, Office of Pollution Prevention and Toxics
U.S. Environmental Protection Agency

Dr. Sanders is Director of the U.S. Environmental Protection Agency's (EPA's) Office of Pollution Prevention and Toxics (OPPT). OPPT plays a lead role in promoting pollution prevention both within the Agency and with states, tribes, communities, and industry. Previously, Dr. Sanders served as the Agency's Senior Executive for Resources Management Training in the Office of Administration and Resources Management and as the Director of EPA Region 5's Environmental Sciences Division. Dr. Sanders holds a Ph.D. in Environmental and Occupational Health Sciences from the University of Illinois, an M.S. in Management of Public Service in Quantitative Methods from DePaul University, and a B.S. in Civil Engineering from the University of Illinois.

Welcome to "Apparel Care and The Environment: Alternative Technologies and Labeling."

The U.S. Environmental Protection Agency's (EPA's) Office of Pollution Prevention and Toxics (OPPT) is proud to co-sponsor this conference and bring together members of the textile, apparel, and cleaning industries to discuss the issue of reducing the environmental impacts of apparel care.

Our goal for this conference is two-fold:

1. To inform you about current alternative technologies and care labeling issues that may affect your industry.
2. To foster a working relationship among all of you that will lead to positive environmental changes in your industry.

An additional challenge for us over the next 2 days is to map out an action plan that will ensure protection for the environment and continued success for the apparel care industry.

More broadly, we hope this meeting will help the apparel care industry in their continuing quest to provide high-quality, cost-efficient, and environmentally sound goods and service to their customers.

We've got a full agenda ahead for the next 2 days. In the first session this morning, we will review what EPA has accomplished in the past few years in cooperation with the dry cleaning industry, and current projects that are underway.

- I will be speaking to you about the Design for the Environment (DfE) Program.
- Ohad Jehassi will provide details about the Design for the Environment Program's Dry Cleaning Project.
- Joseph Breen will give a report on one aspect of the Dry Cleaning Project, the Cleaner Technologies Substitutes Assessment.
    - Over the past few years, EPA has used this tool to evaluate the cost, performance, and environmental and health risks of individual technologies as well as the respective "trade-offs" for a given industry.
- EPA has also sponsored a research program on alternative textile care technologies. Perry Grady (North Carolina State University) and Charles Riggs (Texas Woman's University) will share their research findings with us.

In this afternoon's session, we are going to discuss recent developments in textile care and begin to address care labeling issues.

- International colleagues will share developments that have emerged and techniques that have been tried in Germany, the Netherlands, and France.
- Jo Patton of the Center for Neighborhood Technology will share the results of wet cleaning demonstration projects conducted here in the United States.

Tomorrow we explore in depth one of the main issues of this conference—Care Labeling:

- Representatives from the Federal Trade Commission; the textile, apparel, and fabric care industries; and retailers and consumers will all share their perspectives on this issue.
- With the help of a facilitator, we will be summarizing the meeting and developing an action plan for the future.

While we do not necessarily expect to reach any final decisions on the complicated issue of care labeling, it is our hope that the perspectives presented here and the discussions that follow will help define the issues involved and focus our efforts. In addition, we hope that all of you will take advantage of the contacts made here and continue to work together in good faith toward the common goal of a healthy environment.

And now, I'd like to briefly share with you some of the history and background of OPPT's involvement with the apparel care industry.

In 1990, OPPT was looking for ways to streamline the regulatory risk process. In the past, this process relied heavily on controlling the release of specific chemicals into a particular environmental media—water, air, or land. With this approach, EPA had accomplished much, but along the way some drawbacks had emerged:

- Regulations sometimes proved to be burdensome, inflexible, and resource intensive for both government and industry.
- While some regulations solved one environmental problem, they sometimes created a different problem at the same time, often by transferring pollution from one media to another.
- Some industries replaced regulated chemicals with other nonregulated chemicals that were also hazardous to the environment.

At the same time, however, industry was responding to regulations in positive, proactive ways:

- A number of companies discovered that pollution prevention was a cost-effective way to comply with regulations and help the environment. Many businesses devised innovative ways to substitute, reduce, or eliminate toxic feedstocks and waste streams.
- Industries that were already designing products for marketability and safety began to "design for recyclability" and "design for the environment" as well.

In the early 1990's, the Office of Pollution Prevention and Toxics established its DfE Program.

- DfE was created to help the private sector develop alternative approaches to environmental management as well as to leverage government resources to accomplish public sector environment goals.
- DfE has worked toward these goals through voluntary partnerships with industries such as printing, metal finishing, and, of course, dry cleaning.

In its partnerships with industry, EPA's Design for the Environment Program systematically:

- Identifies alternative technologies, products, and processes for preventing pollution.
- Evaluates and compares the risk, performance, and cost tradeoffs of these alternatives.
- Disseminates this information to the industry community and other interested parties.

In addition to these voluntary partnerships, EPA's Design for the Environment Program sponsors two other key initiatives:

- DfE's Institutional Projects work with the accounting, insurance, and finance industries to ensure that the environmental and economic savings of implementing innovative pollution prevention methods are adequately measured so they can be factored into business planning.
- DfE's Green Chemistry program, through research, review, and curriculum development, recognizes and supports fundamental breakthroughs in chemistry that are cost-effective, useful to industry, and prevent pollution.

The Design for the Environment Program does not, however, recommend specific alternatives. Instead, it provides decision-makers with information, tools, and incentives so that they can make informed decisions that integrate risk, performance, and cost concerns.

There are many potential benefits to DfE projects, including:

- Consumers and workers benefit from reduced health, safety, and ecological risks.
- Preventing pollution can help an industry's bottom line. A successful project reduces regulatory burden, reduces liability and insurance costs, and at the same time it increases efficiency, increases customer acceptance, and improves worker moral and productivity.
- The relationships developed during the cooperative effort of a DfE project can, in the future, contribute to

increased efficiency in handling environmental concerns.

In the 1990's, businesses face many competing demands—keeping costs low and quality high, competing in the global marketplace, and meeting consumer preferences for environmentally friendly goods and services. EPA's Design for the Environment Program strives to assist companies in meeting all of these goals while at the same time lessening an industry's impact on the environment. Through this conference and other key initiatives, we hope to help all of you, and the public at large, become more aware of technologies and issues that are shaping the garment care industry. It is our hope that armed with this information, you can make decisions that are both good for business and good for the environment.

EPA's Design for the Environment (DfE) Program for the Dry Cleaning Industry

Ohad Jehassi

U.S. Environmental Protection Agency

Mr. Jehassi is an economist currently working with the U.S. Environmental Protection Agency's (EPA's) Administrator's Office. In this role, he evaluates the effectiveness of EPA's voluntary and partnership programs. Formerly with EPA's Design for the Environment Program, he managed the development of the dry cleaning project. Mr. Jehassi's experience includes work on various regulations covering lead, cadmium, and formaldehyde, and the development of models predicting the effects of risk communication on consumer behavior. He holds an M.S. in Public Management and a B.S. in Economics from Carnegie Mellon University.

I am honored to be here today to speak to you about EPA's Design for the Environment Dry Cleaning Project. Dr. William Sanders has given us an interesting glimpse inside the Design for the Environment Program's history, initiatives, and goals.

In my work on just one of these initiatives, the Dry Cleaning Project, I have witnessed many positive changes—and encountered a few obstacles as well—during the Project's 4-year quest to explore environmentally responsible cleaning methods.

In my remarks today, I would like to discuss EPA's role in these changes. EPA initially became involved with the dry cleaning industry because of its use of perchloroethylene (perc), a chemical that has been designated as a hazardous air pollutant under the Clean Air Act. Perc has been found at the highest concentration in urban outdoor air, the indoor air of cleaning shops and nearby residences, the homes of dry cleaning workers and customers, as well as in the food, soil, and groundwater near dry cleaning sites.

The dry cleaning industry's use of perc affects a large number of people. In fact, with more than 30,000 commercial dry cleaning shops in neighborhoods and malls across the country, dry cleaners make up one of the largest groups of chemical users that come into direct contact with the general public.

From the beginning, EPA recognized that the dry cleaning industry consists primarily of small, marginally profitable businesses that are least able to absorb the impact of increasing regulations. With these facts in mind, EPA forged a voluntary partnership with the industry to reduce exposure to dry cleaning solvents through safer work practices and alternative technologies.

Toward this end, the Project's primary objectives are to:

- Identify and evaluate pollution prevention options
- Empower dry cleaners and the public with information
- Provide incentives for dry cleaners and the public to change behavior

The birth of the Dry Cleaning Project marked a fundamental shift in the way EPA does business. EPA had never before attempted to work together so closely with an industry. In addition, rather than reducing risk through command and control regulation, EPA used its resources to support innovation and research and development. This project also marks the first time EPA has convened a group as diverse as the Dry Cleaning Project's stakeholders.

The partners in this project include:

- Environment Canada
- Trade associations
- Labor unions
- Chemical companies
- Government purchasing authorities
- Academia
- Environmental and consumer groups

The Dry Cleaning Project has accomplished much since its inception in 1992. The project has:

- Formed partnerships among industry, labor, environmental, and consumer groups. Among these partners are the co-sponsors of this conference, and I would like to take this opportunity to thank:
  - American Apparel Manufacturers Association (AAMA)
  - American Association of Textile Chemists and Colorists (AATCC)
  - American Textile Manufacturers Institute
  - American Society for Testing and Materials (ASTM)
  - Fabricare Legislative and Regulatory Education (FLARE)
  - Professional Wet Cleaning Partnership (list partners)
- Jointly identified and evaluated alternative technologies

  The alternative technologies identified have included wet cleaning, a process of controlled application of soap and water, and alternative solvent-based cleaning. The Project is also examining other alternative cleaning methods, including liquid carbon dioxide and ultra-sonic technologies. Dr. Joseph Breen will discuss the technologies assessed in the Cleaner Technologies Substitutes Assessment, or CTSA, in more detail immediately following my remarks.
- Successfully tested alternative wet cleaning methods

  In 1993, in preparation for producing the CTSA, EPA compared the costs and performance of perc-based dry cleaning against a cleaning method known as multiprocess wet cleaning. Findings from this preliminary, short-term study encouraged us to further research wet cleaning.
- Established demonstration sites

  Two machine wet cleaning demonstration sites, one in Chicago and the other in Los Angeles have been established to collect information on performance, cost, and customer satisfaction. The sites mirror typical neighborhood dry cleaning shops and offer dry cleaners the opportunity to observe wet cleaning under long-term "real-world" conditions. This afternoon, Jo Patton from the Center for Neighborhood Technology will present some of the results of these demonstration projects.
- Developed a training program for dry cleaners

  EPA is sponsoring the development of a curriculum and related workshops to reduce the use of perc. Focusing on alternative cleaning technologies, especially machine wet cleaning, this course also covers economics, worker health and safety, and liability issues.
- Outreach activities

  To educate consumers and dry cleaners about ways to reduce the risks associated with dry cleaning, DfE and its project partners have created a variety of informational materials. These materials include brochures, fact sheets, case studies, televideo conferences, educational videos, and pollution prevention manuals.
- As a direct result of the project's involvement in wet cleaning, nearly 100 shops that offer wet cleaning services have opened or made the switch to wet cleaning in the past 18 months.
- Initiated changes in care labels to allow for alternative care methods

  Early on in the evaluation process, the Dry Cleaning Project recognized that one of the key obstacles to implementing alternative, environmentally friendly technologies is care labeling. Accordingly, the DfE Dry Cleaning Project asked the Federal Trade Commission to revise its Care Labeling Rule to require textile manufacturers to explicitly state whether a garment can be safely cleaned by solvent-based methods, water-based methods, or both. We believe this change is necessary to advance the use of water-based cleaning methods.

  The Care Labeling Rule now states *"if either washing or dry cleaning can be used on the product, the label need have only one of these instructions."* We believe that amending the rule would allow consumers, as well as professional cleaners, to make more informed choices as to whether garments can be dry or wet cleaned. It would also encourage the use of water-based cleaning methods without the threat of resulting garment damage and subsequent damage claims on professional cleaners.

  There are also a number of ongoing activities:
- U.S. Small Business Administration Workshops to be held across the country

- U.S. Navy/Army Testing Program will test the wet cleaning process on "dry clean only" military garments

In the next day and a half we will be hearing different perspectives on the care labeling issue and hopefully reaching some agreements on how best to address the questions and concerns of everyone here today.

I hope that my remarks this morning have provided all of you with an adequate overview of the DfE Dry Cleaning Project. EPA's Office of Pollution Prevention and Toxics is committed to helping the garment care industry continue its history of customer satisfaction during this time of change. Working together, we can reduce the risks of dry cleaning solvents and provide a safer, healthier environment for dry cleaners and their customers. All of the apparel care representatives here today — from textile manufacturers, trade associations, the Federal Trade Commission, researchers, to our European colleagues — have a role to play in preventing pollution. We hope this meeting will serve as a constructive forum to exchange ideas about where we now stand, and what is indeed possible for the future.

1

Design for the Environment
Dry Cleaning Project
Partnerships for a Cleaner Future

2

Technical Work

Goal: A Cleaner Technology Substitutes Assessment (CTSA) provides a comparative evaluation of alternatives in terms of risk, performance, cost, and other environmental effects to prevent pollution, reduce risk, and improve economic productivity

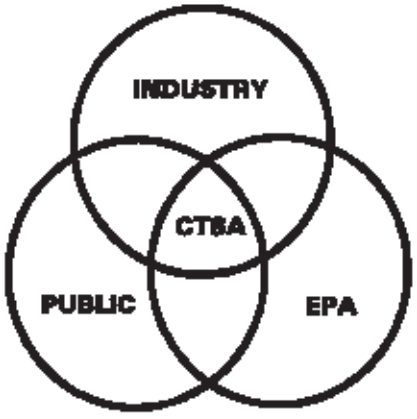
3

Dry Cleaning Project

- **Partnership formed in May 1992**
- **Goal: Reduce exposure to dry cleaning solvents**
- **Objectives:**
  - **Identify and evaluate pollution prevention options**
  - **Empower dry cleaners and public with information**
  - **Provide incentives for dry cleaners and public to change behavior**

4

Stakeholders



- **Amalgamated Clothing and Textile Workers Union**
- **Canadian Fabricare Association**
- **Consumers Union**
- **Dow Chemical Company**
- **Environment Canada**
- **Greenpeace**
- **Halogenated Solvents Industry Alliance**
- **International Fabricare Institute**
- **Massachusetts Toxics Use Reduction Institute**
- **Neighborhood Cleaners Association**
- **U.S. Environmental Protection Agency**

5

Sponsors

- American Apparel Manufacturers Association (AAMA)
- American Association of Textile Chemists and Colorists (AATCC)
- American Textile Manufacturers Institute (ATMI)
- American Society for Testing and Materials, Committee D13 on Textiles (ASTM)
- Fabricare Legislative and Regulatory Education Organization (FLARE)
- Professional Wet Cleaning Partnership (PWCP)
- U.S. Environmental Protection Agency (EPA)

6

Project Accomplishments

- Formed partnerships among industry, labor, environmental, and consumer groups
- Jointly identified and evaluated alternative technologies
- Successfully tested alternative wet cleaning methods
- Established alternative technology demonstration sites

7

Project Accomplishments

- Developed training curriculum for dry cleaners
- Outreach activities
- More than 80 wet cleaning shops have opened in North America in the last 18 months
- Initiated change in apparel care labels

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Ongoing Activities

- SBA workshops
- U.S. Navy/Army testing program

EPA's Cleaner Technologies Substitutes Assessment for the Dry Cleaning Industry: A Real World Industrial Ecology Example

Joseph Breen

U.S. Environmental Protection Agency

Dr. Breen is Chief of the U.S. Environmental Protection Agency's (EPA's) Design for the Environment Program within the Office of Pollution Prevention and Toxics (OPPT). OPPT plays a lead role in promoting pollution prevention both within the Agency and with states, tribes, communities, and industry. Prior to assuming his present duties as head of the Design for the Environment Program, Dr. Breen served as Chief of the Field Studies Branch and Industrial Chemistry Branch in OPPT. Dr. Breen earned a Ph.D. in chemistry from Duke University.

I'd like to add an industrial ecology perspective before I get into a discussion of the Cleaner Technology Substitutes Assessment (CTSA). What I want to share with you is this graph (slide 2). It's from the President's Council on Sustainable Development and it lays out a 50-year strategic plan for technology development at the end of the 20th century and the first part of the 21st century. What it shows are four lines, one each for remediation and restoration, control, monitoring and assessment, and avoidance or pollution prevention. The point is that at the end of the 20th century, we're spending a lot of effort and monies on remediation, restoration, and control. The long-term strategic plan, however, is to have pollution prevention be the paradigm in order to avoid having to expend major effort on remediation and restoration or, for that matter, on control. If you don't create the pollution in the first place, then you don't have the cost of cleaning it up, controlling it, or the liabilities associated with it.

The Dry Cleaning Project is an excellent illustration of industrial ecology because, although it started out dealing with the issue of environmental and worker exposures to perchloroethylene (perc), we now have new technologies that are coming forward and we've even changed the people that are participating in the process. It's not only the small "mom and pop" dry cleaners, the franchise people, or the hardware and the solvents people who are involved in this, but also we're now talking to the people who actually produce the garments themselves and to the people who produce the textile fibers from which the garments are made. This is part of the ecological web notion here in an industrial setting. We are trying to influence the chemistry of the polymers and the surface finishes used in and on the garments in order to make them more amenable to pollution prevention technologies for the fabric care industry. I think that is pretty exciting.

Just to quickly reiterate the Design for Environment (DfE) vision, it's the simple notion of taking classical cost and performance parameters as a basis for decision-making and including an environmental component. The mission of our program is to use the Office of Pollution Prevention and Toxics (OPPT) risks management expertise to help inform business decisions to affect behavioral change. As Bill Sanders, the Director of OPPT, has indicated in his remarks, one of the hallmarks of the DfE program is that it is a voluntary program involving partnerships to empower the participants to move forward toward pollution prevention. Ohad Jehassi has indicated that the stakeholders in the Dry Cleaning Project include not only the U.S. Environmental Protection Agency (EPA) and industry, but also the public sector and environmental and labor groups as well.

Which brings me to what I have been charged with, to provide you with a thumbnail sketch of what a CTSA is all about. A CTSA is a systematic comparison of the performance cost and human health and environmental risks associated with chemicals, processes, and technologies. The goal is to evaluate the traditional as well as the alternative technologies, to evaluate substitutes, and to evaluate control options.

The idea is to lay out the tradeoffs among the options in order to facilitate informed decisions. It turns out that if you look at what is required to go into a CTSA, you create a rather daunting matrix of modules. They include basic chemical information, human health and hazard summaries, the environmental hazard summaries, and the market information process description. The modules also include exposure issues that get compiled into a risk assessment including safety and process hazard issues, evaluation of the P2 options, and some ancillary information on the regulatory status and performance and social costs and benefits. Completing this matrix is a rather formidable task. In this particular case where we are looking at substitute technologies, we take all of those module elements and array them for the various substitute technologies in a data matrix.

In the case of the dry cleaning technology assessment, we've been charged with taking the existing technologies and some newly available ones to fill in the matrix that I've just presented. The more challenging aspect is to also get a handle on those technologies under development and for which the data base is extremely limited. These new technologies include efforts to deal with petroleum solvents, various fluorocarbons, and liquid carbon dioxide. What's unique or exciting, for me at least, is the emergence by virtue of this process here in the United States of us giving serious consideration to substitutes for traditional dry cleaning. We've been working on the wet cleaning processes with our colleagues here in the United States and in Canada, and we've had more recent efforts with the people in Europe such as in Germany. Again, the challenge is to pull together the information which, in many cases, is somewhat limited because the technologies are fairly new.

What Lynn Blake-Hedges, the CTSA Project Manager, and the Dry Cleaning Work Group at EPA are doing is assembling a table that looks something like this. It takes all of the modules I showed in the previous graphic (slide) and fills in the boxes to make a comparison across the technologies. The objective of the comparison is *not* to dictate what technology to choose. The objective is to provide the information so that informed decisions can be made. A decision one individual might make may differ from another individual, depending on their particular circumstance. Circumstances such as the capital investment they're confronted with, and whether they've recently made investments in a particular technology or not.

Once the CTSA is completed, the challenge is to communicate it to the industry and to consumers. Lynn Blake-Hedges and the Work Group are working diligently to integrate Phase I, which is the CTSA for the perchloroethylene (perc) and petroleum solvents. The Phase II document covers all of the other technologies listed in the matrix. The timetable is to complete that process by the end of the year. This particular document has to go into peer review, and we look for that to happen this winter. We're optimistic we will release the integrated Phase I and Phase II CTSA sometime in late spring of 1997. For those of you that have been involved in the process, you know there has been some difference of opinion associated with the CTSA, particularly in the area of risk characterization. We continue to work with Bill Sanders and Lynn Blake-Hedges to come up with an appropriate presentation of the risk characterization, in order to meet our objectives.

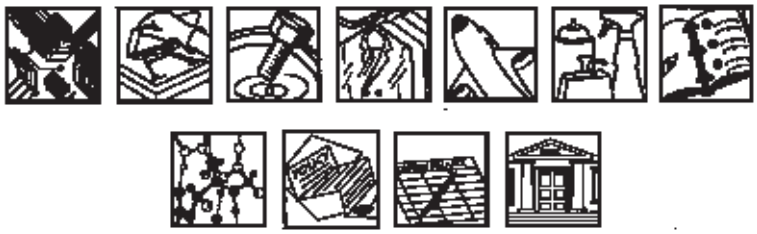
I must tell you, as someone who has been at EPA since 1977, the DfE Program and particularly the fabric care project (I find myself no longer using the word "dry cleaning" because I think we've gone beyond that to include other processes) is one of the most exciting things that I've been involved in professionally. We're really making a change in the way people do business. We are now starting to impact the garment industry, and ultimately we'll be impacting the polymer industry. For us, that comes full circle, because OPPT also has the Green Chemistry program which is trying to come up with environmentally benign ways of doing chemical synthesis. All of a sudden, we have this unusual circumstance of us working with chemists like Professor Joe DeSimone at the University of North Carolina on the Green Chemistry side, who runs polymer reactions in environmentally benign solvents such as liquid carbon dioxide. That information has implications for developing chemicals, such as surfactants and finishes, that will be used in the fabric care industry particularly the use of liquid CO_2 as a fabric cleaning solvent. It's a marvelous example of industrial ecology at work.

1

Design for the Environment EPA

Design for the Environment

Partnerships for a Cleaner Future



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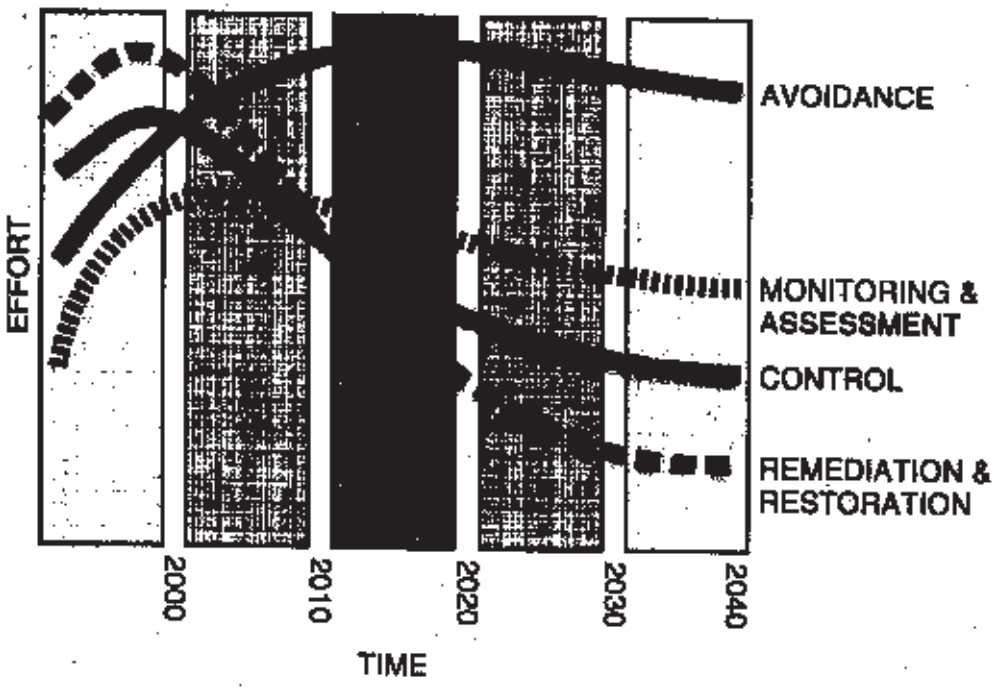
Industrial Ecology: Technology Development



Stephen M. Edgington, "Industrial Ecology. Biotech's Role in Sustainable Development." *Bio/Technology*, Vol. 13, p. 31.

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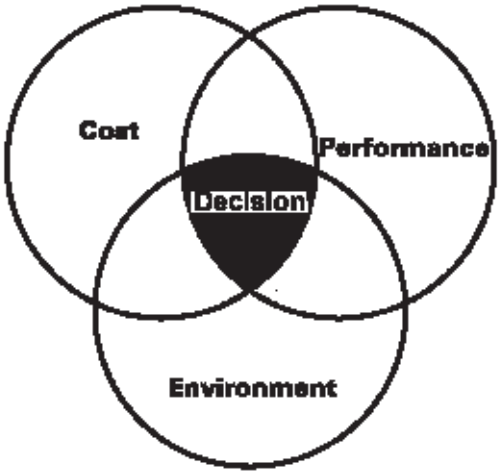
DfE Vision:

- **Business decision-makers integrate environmental concerns into cost and performance criteria**



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DfE Mission:

- **Use the Office of Pollution Prevention and Toxics' risk management methodology to inform business decisions**

Information + Incentives = Behavior Change

5

What Is a Cleaner Technology Substitutes Assessment (CTSA)

- **A systematic comparison of the**
  - Performance
  - Cost
  - Human health and environmental risk

  associated with chemicals, processes, and technologies

6

Goal of the CTSA:

- **To evaluate**
  - Traditional and alternative technologies
  - Substitutes
  - Control options
- **To lay out the trade-offs among the options**
- **to facilitate informed decisions**

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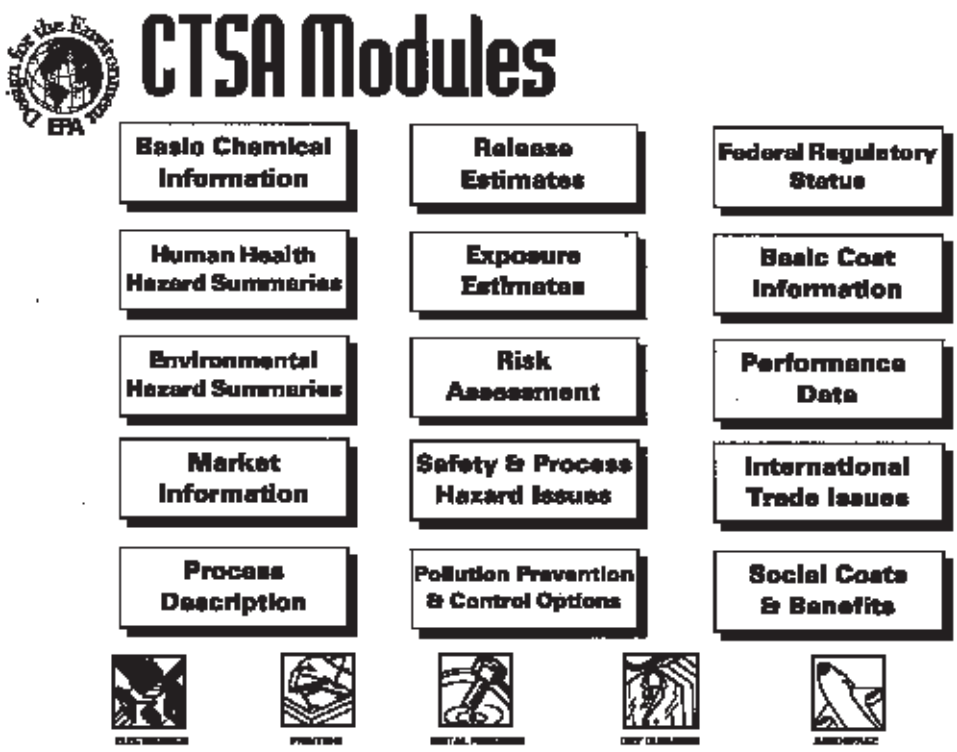
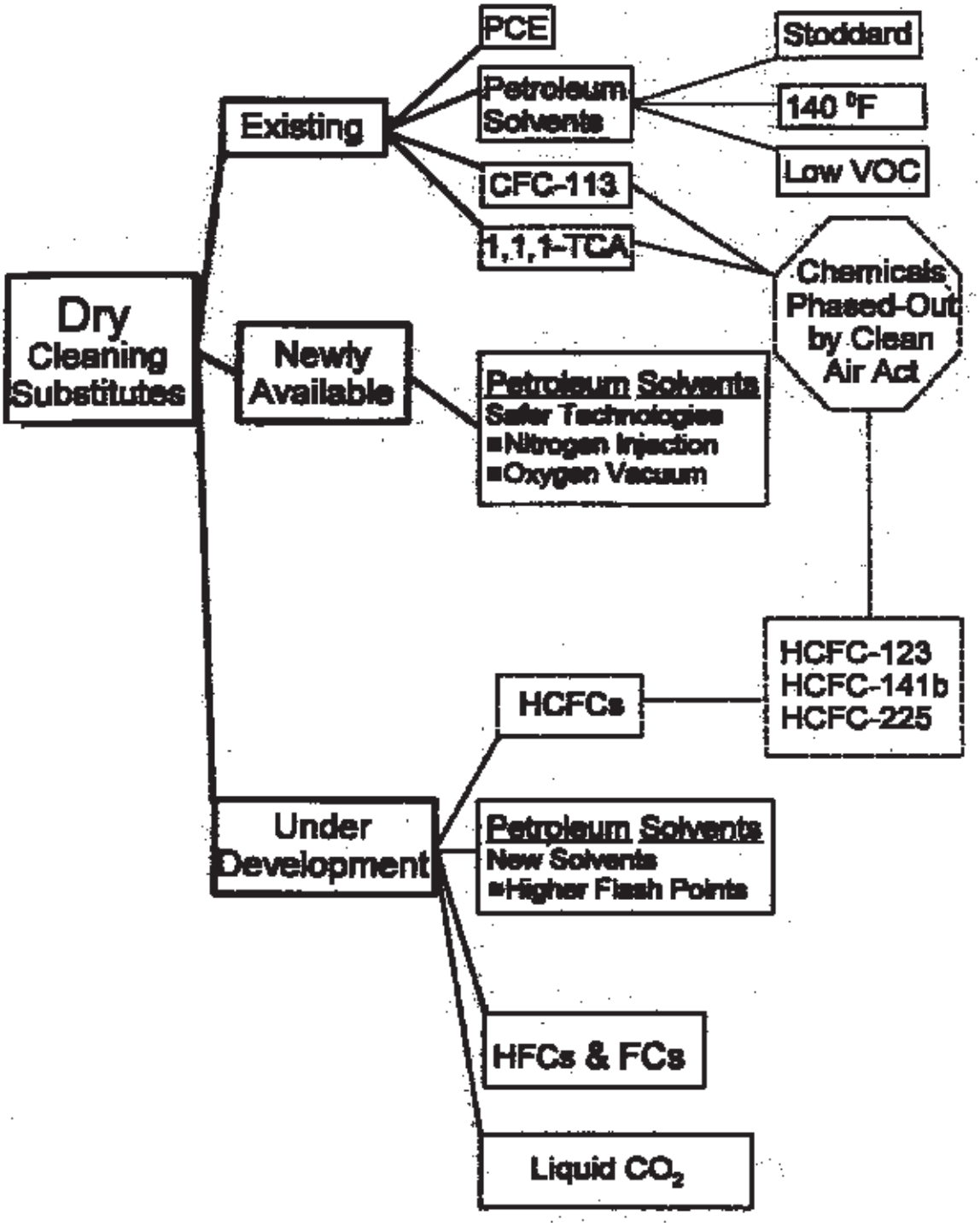

CTSA Modules
Basic Chemical Information
Release Estimates
Federal Regulatory Status
Human Health Hazard Summaries
Exposure Estimates
Basic Cost Information
Environmental Hazard Summaries
Risk Assessment
Performance Data
Market Information
Safety & Process Hazard Issues
International Trade Issues
Process Description
Pollution Prevention & Control Options
Social Costs & Benefits

8

EXISTING AND EMERGING DRY CLEANING ALTERNATIVES



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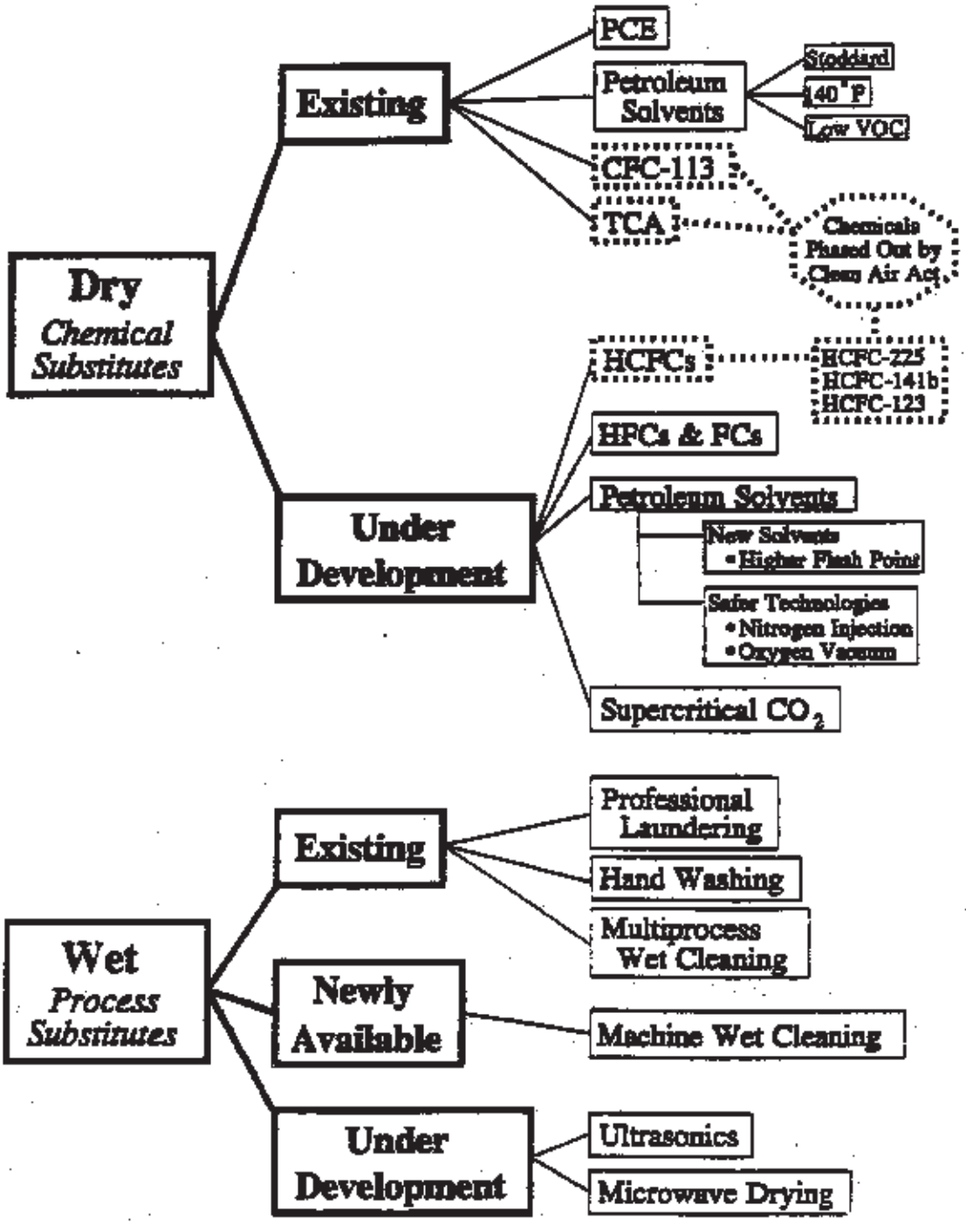
Clothes Cleaning Alternatives



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Alternative Fabricare Technologies Comparison Chart

CHARACTERISTIC	PERC	PS	WET CLEAN	CO_2	MICROWAVE	ULTRASONIC	NEW PS
Chemical Use							
Solvent Use	gal/yr	gal/yr	N/A	gal/yr	N/A		gal/yr
Solvent Mileage	lbs/gal	lbs/gal	N/A	lbs/gal	N/A		lbs/gal
Hazard							
Cancer							
Non-Cancer: Neurotoxicity							
Non-Cancer: Irritant							
Non-Cancer: other							
Environmental							
Flammability							
Human Exposure							
Worker Inhalation							
Worker Dermal							
Adjacent Resident							
Relative Risk							
Cancer							
Non-Cancer							
Environmental							
Costs							
Maintenance Costs	$	$	$	$	$	$	$
Capital Costs	$	$	$	$	$	$	$
Annual Operating Costs	$	$	$	$	$	$	$
Total Annual Costs	$	$ range	$	$	$	$	$
Consumer Issues							
Clothing Applicability							
Odor							
Cleaning Performance							

EPA's ORD Research Program on Alternative Textile Care Technologies: Part I

Charles Riggs

Texas Woman's University

Dr. Riggs is a professor at Texas Woman's University (TWU) in the Department of Fashion and Textiles. He has been involved in research, teaching, and professional service to the laundry and dry cleaning industry for more than 20 years. In addition to teaching and research duties at TWU, he serves as Director of the Texas Research Center for Laundry and Dry Cleaning. The Center was founded in 1983 as a cooperative effort between TWU and the Southwest Dry Cleaning Management Institute. Dr. Riggs holds a Ph.D. in Chemistry.

I wanted to give you a little bit of history. The Research Center for Laundry and Dry Cleaning at Texas Woman's University (TWU) was founded in 1983 with the sole purpose of providing a center in Texas for research and training in laundry and dry cleaning. The Texas Laundry and Dry Cleaning Association uses the center as a training facility. The association worked with the manufacturers of professional cleaning equipment to provide the university with the equipment. In 1983, it amounted to about a half million dollars of donated equipment to put the center together. Since that time, there has been some evolution of the equipment and some replacement; we are trying to keep it up to date. This project will probably bring us to the cutting edge of technology at the center. TWU also runs the center as a production plant where we service the uniforms on campus and do over-the-counter work. The project will, indeed, give us access to typical customer items, and we can collect data in that form.

TWU has very active participation with industry, and I wanted to give credit to our partners within the industry who have long supported our research programs at TWU. We have worked with the Southwest Drycleaners Association, the Textile Rental Service Association of America, and the Uniform and Textile Services Association of America. For the project we're speaking about today, we are in partnership with North Carolina State University (NCSU). The two universities jointly responded to a request for proposals for Testing and Development of Pollution Prevention Alternatives to Reduce Indoor Air Emissions from Perchloroethylene Dry Cleaning and Dry Cleaned Fabrics from the U.S. Environmental Protection Agency (EPA) and we were successful in receiving the funding. It was mentioned earlier that I would speak about results, but results are not yet completed. In fact, the project is just beginning, so, rather than talk about results, Dr. Perry Grady and I will talk about our intentions. I think the timing is excellent because this gives us a chance to respond to your concerns and input as to what directions we should follow with the project. NCSU, with its engineering capability, will identify and screen new technology, and, in many cases, build equipment to evaluate how well it will clean and perform. At TWU, with our operating plant, we will be looking at technology currently available to the industry. Then together, we intend to develop a protocol that would be universally acceptable to evaluate cleaning technology. Certainly our intention is to learn from the European research organizations and not try to deviate from what's being done in Europe. In fact, one of our students has just returned from 2 weeks at the Hohenstein Institute, learning the European protocol for wet cleaning assessment, which we will try to adapt as closely as possible in our trial efforts.

Dry Cleaning Technology

Perchloroethylene (perc) is indeed the most commonly used solvent. There's also solvent cleaning with hydrocarbons, and both hand and machine wet cleaning. What we're talking about here today is more machine wet cleaning and the distinction is more of a production technique. At this point companies have already contributed to help support this project with EPA. We have the wet cleaning machine from UNIMAC in place and running and a drying cabinet from Aquatex (a central part of the wet cleaning procedure is to be able to dry without agitation). Boewe-Passat, Permac division is sending two machines, a perc machine and a hydrocarbon dry cleaning machine. We will be using the Exxon synthetic hydrocarbon solvent DF2000. Our assessment is that this solvent would provide the most reproducible results since distilled hydrocarbons vary somewhat in composition from one

manufacturer and one distiller to another. We are still optimistic that we can actually evaluate the carbon dioxide technology. It's not currently available to the industry, but projections are that it will be available in the near future. So, if we have a machine available which is characteristic of what will be sold to the industry, then we will also include that technology in our assessment.

I wanted to review some of the basic concepts so you would appreciate some limitations of the project. In typical solvent cleaning, the process is one of cleaning, filtering, distilling, and reusing the solvent within the cleaning plant. So, this industry is indeed one that is a recycling industry and always has been. Solvents are most effective on oily type soils. In fact, very little additive is necessary to remove oily soils from fabrics, but it's quite difficult to remove water-soluble soils such as perspiration, salt, and sugar. Some fibers are sensitive to solvents, and some dyes and finishes are removed by solvents. As has already been stated, perchloroethylene has the advantage of not being flammable, but it has health and environmental concerns; whereas, hydrocarbons are flammable, and they may also pose some long-term health and environmental concerns. For wet cleaning, we want to distinguish that this is not laundering; this is not a technique that would be practiced at home. It would require the care and training of a professional. In the case of wet cleaning, the water is discharged to the sewer so there may be some environmental consequences to consider. Wet cleaning is most effective on water-soluble soils, and the problem soils are oil-based and would require additives to remove. Again, we have a fiber compatibility problem. We may see some shrinkage with fibers such as wool and rayon, and some dyes are water soluble. In the past, the garment manufacturers have selected care labels for laundering instructions or dry cleaning instructions based upon those compatibility problems with fibers and dyes. As we began to look at using wet cleaning as an alternative to dry cleaning, we find compatibility problems that require careful attention. Our objective, in part, is to evaluate the cleaning technology. We looked at this from a consumer's perspective in terms of what does the consumer expect from taking something in to have it cleaned. Getting the garment back clean without damage is a prime consideration. And, indeed, our protocol would be to look at the ability to clean as well as the consequences to different kinds of fabric.

Performance Criteria

For each technology, we want to identify problem soils. We already know part of our results for wet cleaning—problem soils are those containing an oily component. For solvent cleaning, it would be those containing a water-soluble component. We also want to identify for each technology what fabrics create problems. We have some indications in terms of what can be possible for care labels. We also, at some point, (and this is not currently funded under the project) need to evaluate variables brought about from the manufacturers in terms of how the garments are constructed. We've already found some anecdotal cases in terms of how fabrics that are fused respond differently to the different cleaning technologies.

To evaluate cleaning performance, our plan is to look at some of the standard cleaning assessments swatches available from the International Fabricare Institute and European laboratories. The objective is to adequately represent what a consumer might expect in terms of soil removal from a garment. We also are going to be selecting fabrics to evaluate. The ones that we feel are fairly obvious to look at are those that would be difficult to launder, or those that would normally be sold at this time with a "dry clean only" label: wools, silks, rayons, and some acetates. The project is not designed to look at the whole laundering issue in terms of evaluating launderable fibers like cotton and polyester, but to look at the fibers that would be difficult if we had to suddenly eliminate solvent cleaning. The objective for each of these technologies is to identify problem areas and limitations, specifically with regard to what soils they can handle and what fabrics can be safely processed. This research would provide the American Association of Textile Chemists and Colorists and the American Society for Testing and Materials with information that would have an impact on revisions of care labels, so that the care label coming to a cleaner would give them proper instructions as to what they can and cannot do with a garment. One of the keys is to provide a technology or a protocol by which we could look at cleaning technologies and make a comparison of how the technologies perform in terms of soil limitations and fabric limitations. Being optimistic, what kind of objectives might we then follow up with when this project is finished? The objective would be certainly to continue this kind of dialogue with this kind of group and continue to establish better communications between the cleaning industries and the apparel manufacturers. We wish also to acknowledge that we plan to learn from our colleagues in Europe. I see no reason for us to spend money to evaluate technology that they've already looked at, so we're looking forward to an ongoing dialogue with European and other international organizations in terms of this technology.

1

Texas Research Center History

- Established in 1983 to provide a facility for research and training in laundering and drycleaning
- Donation of equipment by manufacturers coordinated by the Texas Laundry and Drycleaning Association (TLDA)

2

Texas Research Center Industry Partners

- SDA (Southwest Drycleaning Association) previously TLDA (Texas Laundry and Drycleaning Association)
- TRSA (Textile Rental Services Association of America)
- UTSA (Uniform and Textile Services Association of America)

3

Texas Research Center Related Programs

- Drycleaning and laundering courses—sponsored by SDA
- Production Management Institute—cosponsored by TRSA and UTSA
- Maintenance Management Institute—cosponsored by UTSA and TRSA
- Research—sponsored by Texas Food and Fibers Commission (TFFC) and EPA

4

Testing and Development of Pollution Prevention Alternatives to Reduce Indoor Air Emissions from Perchloroethylene Dry Cleaning and Dry Cleaned Fabrics

5

North Carolina State University College of Textiles

&

Texas Woman's University

Texas Research Center for Laundry and Drycleaning

6

- NCSU—Identify and Screen New Technology
- TWU—Evaluate Currently Available Technology
- Both—Develop Universally Accepted Procedures to Evaluate Cleaning Technology

7

Current Cleaning Technology

- Solvent Cleaning Using Perchloroethylene is Most Common Method
- Solvent Cleaning Using Hydrocarbons
- Wet Cleaning—Machine and Manual

8

Plant Scale Equipment

Texas Research for Laundry and Drycleaning

Project Contributors:

UniMac Company—	Wet Cleaning Machine, Model UA230, with Seitz Chemicals
	ADC Dryer Model UD80 with Microcomputer
	$10,000 for supplies
AquaTex—	Drying Cabinet
Böwe Passat—	P546 46 lb, Perchloroethylene Drycleaning Machine
Exxon—	DF2000 Hydrocarbon Solvent
Pending—	Liquid Carbon Dioxide Cleaning Machine

9

Solvent Cleaning

- Solvents are filtered, distilled, reused at the cleaning plant
- Most effective on oily type soils—require additives to remove water soluble soils
- Some fibers are sensitive to solvents
- Some dyes and finishes are removed by solvents

10

Solvent Cleaning

- Perchloroethylene—nonflammable—health and environmental concerns
- Hydrocarbons—flammable—may be health and environmental concerns

11

Wet Cleaning

- Not laundering
- Water discharged to sewer
- Most effective on water soluble soils—additives required to remove oily type soils
- May cause shrinkage of wool, rayon
- Some dyes are water soluble

12

Evaluating Cleaning Technology

- Ability to Clean
- Minimum Damage to Garment

13

Performance Criteria

- Soil Removal—Identify Problem Soils
- Fabric Damage—Identify Problem Fabrics
- Variables in Garment Construction

14

Soil Removal Standards

- IFI Cleaning Performance Test
- Krefeld Standard Soils
- TNO Standard Soil
- Others

15

Fabric Selection

- Wool—Lightweight, Worsted, Woven
- Wool—Heavyweight, Woolen, Woven
- Wool—Medium Weight, Woolen, Knit
- Silk—Lightweight, Woven
- Rayon—Lightweight, Woven
- Acetate—Lightweight, Woven

16

Final Report

- Identify problem areas and limitations of each technology
- Provide input through AATCC and ASTM to update care labels
- To provide a universally accepted method of evaluating cleaning technologies

17

Future Objectives

- Establish better communications between cleaning industries and apparel manufacturers
- Form cooperative linkages with international cleaning associations

EPA's ORD Research Program on Alternative Technologies, Part II

Perry Grady

North Carolina State University

Dr. Grady is the Associate Dean of Textiles and Professor of Textile Engineering, Chemistry, and Science at North Carolina State University. He has taught and conducted extensive research in textiles, instrument and control system design and development, computer applications, energy utilization and conservation, and fiber production and properties. Dr. Grady received a Ph.D. in Fiber and Polymer Science, as well as his M.S. and B.S. in Electrical Engineering, from North Carolina State University.

At North Carolina State University, we are principally working on the development of new and existing technologies that may prove to be viable alternatives to the use of perchloroethylene (perc) and other presently available systems. One of the things we're currently working on is ultra-sound cleaning. As most of you know, cleaning variables involve time, temperature, agitation, and chemistry. Ultra-sound may prove to be a substitute for mechanical agitation, water, perc, and hydrocarbon cleaning. It also may substitute, partially at least, for temperature. That is, we may be able to clean at a much lower temperature than we would without ultra-sound. We are looking at ultra-sound both for solvent-based and water-based systems. The ultra-sound for solvent-based cleaning will use perc and DF2000 systems as benchmarks. Just by looking at their properties from the literature and so forth, we have actually screened about 135 different solvents. I think we've used 11 or 12 to actually do some preliminary tests. We have done this as very rough testing. Later, we will use the successful preliminary experiments to do standard tests on fabrics and soils.

Preliminary results for ultra-sound solvent-based cleaning indicate that solvents that work on a soil in normal type drycleaning will work on the same soil much faster with the use of ultra-sound. And the opposite is also true—solvents that don't work on a soil are not going to be effective with ultra-sound. So, in essence, ultra-sound will enhance whatever a solvent's ability has to take off a soil to begin with. In using ultra-sound cleaning on a water-based system, our objective is to develop a greener cleaning system that removes complex soils and eliminates the use of non-aqueous solvents. This may prevent shrinkage in such fabrics as wool because it eliminates most of the usual mechanical agitation that is one of the primary causes of shrinkage, rather than the water. So ultra-sound may give us a way to apply water-based cleaning without all of the agitation. We're finding that a temperature of 122° Fahrenheit gives good results. We get some very good cleaning from this. We have found that using ultra-sound and wet cleaning may give you hand problems, but that's probably due to the fact that we're not tumble drying the garments. We would probably need to find a way to dry them that would enhance the hand by giving some kind of substitute for agitation. As we find systems that work in both the water-based and solvent-based tests, we will use the standard samples and soils so that we will be able to compare all these types of cleaning. In the initial work, which has been going on for some time in ultra-sound, however, we have done very crude screening-type research because it would be too expensive to run all of the standard type soils and samples with this type of experimental apparatus.

In carbon dioxide (CO_2) cleaning, we will focus our research on liquid or subcritical technologies. Originally, we had thought in terms of supercritical carbon dioxide cleaning, but it turns out that supercritical CO_2 may damage buttons and zippers, while subcritical CO_2 seems to work well. When Charles Riggs [EPA's ORD Research Program on Alternative Textile Care Technologies, Part I] was talking about the supercritical or the liquid CO_2 work that they were doing, he was referring to a prototype commercial machine. We are in the process of building a benchtop experimental apparatus so we can get a very wide range of variables and look at the use of surfactants and examine the variables in liquid carbon dioxide cleaning. This will allow us to look at many more things than we could in a pro-

totype system and should tie in very well. Again, for the things we find successful in carbon dioxide cleaning, we will then run those experiments on standard samples, and so forth.

At North Carolina State University, we're using our testing lab to run most of the tests on the samples that Charles Riggs produces as well as those that we produce, so that we can compare them all in one place. As much as possible, we're trying to use American Society for Testing and Materials American Association of Textile Chemists and Colorists type standards so that we will be able to compare with the work that other people do and not have to generate or produce entirely new test methods, although some of that may be necessary.

I have a lot more details on what we're planning to do and even some of the preliminary results. I'll be happy to discuss those now or in the discussion session. I want to reemphasize what Charles Riggs has said, that this project is just getting underway. Most of the work will be done in the coming months. It was proposed and accepted as a 3-year project, but we've only been funded for 1 year. Our results obviously will depend on whether we're able to secure second and third year funding for this work. What we've laid out is primarily for 3 years, but we've tried to adjust the project so that if funding does not come forward for the second and third year we will still produce some useful results even in the first year. We have formed an advisory committee for this project and the first meeting will be Wednesday, September 12, 1996, in Raleigh. We think this is an excellent forum and we would welcome any input you have into the design and direction of this project.

1

Testing And Development of Pollution Prevention Alternatives to Reduce Indoor Air Emissions from Perchloroethylene Dry Cleaning and Dry Cleaned Fabrics

By Perry L. Grady
College of Textiles
North Carolina State University

2

Ultrasound Cleaning

- Cleaning Involves
  - Time
  - Temperature
  - Agitation
  - Chemistry
- US May Substitute for
  - Mechanical Agitation in Water PCE & Hydrocarbon Cleaning
  - Temperature

3

Ultrasound Cleaning

- Solvent Based
  - Benchmarks
    - PCE
    - DF-2000
  - 135 Screened, 11 Used
- Preliminary Results
  - Solvents That Work on a Soil Will Work Faster With US
  - Solvents That Don't Work on a Soil Are Not Effective With US

4

Ultrasound Cleaning

- Water Based
  - Objective:
    - Develop a "Greener" Cleaning System That removes Complex Soils and Eliminates Use of Non-Aqueous Solvents
  - May Not Cause Shrinkage
  - Eliminates Most Mechanical Agitation
- Preliminary Results
  - 122 Degrees F Gives Reasonable Results
- Standard Samples & Soils Will Be Tested

5

Carbon Dioxide Cleaning

- Focus on Liquid (Subcritical)
  - Supercritical May Damage Buttons and Zippers
- Bench Top Experimental Apparatus
- Wide Range of Variables

Apparel Care and the Environment

Alternative Technologies and Labeling

Summary of Discussion

Session I

Ohad Jehassi of the U.S. Environmental Protection Agency (EPA) opened the floor to questions.

Jack Weinberg of Greenpeace remarked that the Design for the Environment (DfE) Dry Cleaning Project has been a great success so far. He stated that the project had been very successful and should be highly lauded. On the other hand, it's far, far from complete. Mr. Weinberg closed by asking what the future holds for DfE and for the Dry Cleaning Project.

Dr. William H. Sanders of EPA responded by stating that what is happening with the program is the same as what's happening with lots of programs that are funded by the Environmental Technology Initiative out of Congress. What happened this fiscal year is that the money the agency received was reduced. The scope of work the Agency is allowed to do has also been reduced. The hope is that next fiscal year the money will be back up to where it has been in previous years. This year the DfE program didn't get full funding. Money out of the Office of Pollution Prevention and Toxics (OPPT) was used to help keep the DfE program going, because they recognize the value of the program.

Mr. Weinberg asked if it was reasonable to assume that the level of activity might not be the same, but that the Dry Cleaning Project would be going on for some time into the future.

Dr. Sanders replied that it is a priority at OPPT to make sure that it does continue on.

Manfred Wentz of the Fabricare Legislative and Regulatory Education Organization voiced his support for the DfE program. It is absolutely essential for the dry cleaning industry to be supported by somebody because the industry itself does not have sufficient funds to attack and resolve some of the larger issues. Dr. Wentz expressed his pleasure that the apparel care industry is making progress towards solving problems.

Ed Wituschek of Environment Canada asked if anyone had information on a human health risk assessment for petroleum solvents. If perchloroethylene (perc) is regulated in Canada petroleum solvents may increase.

Dr. Joseph Breen of EPA noted that the Cleaner Technologies Substitutes Assessment (CTSA) was moving forward.

Kaspar Hasenclever, Kreussler, Wiesbaden, Germany, provided a response to Mr. Wituschek's question. In metal cleaning and dry cleaning, hydrocarbon solvents are used in processes that have recycling, so that these solvents will not directly affect the workers. It was judged that the risks coming from hydrocarbon solvents in dry cleaning was low enough that you could negate them.

Apparel Care and the Environment

Alternative Technologies and Labeling

Summary of Discussion

Session I (Continued)

Bill Seitz of the National Cleaners Association - International (NCA-I) corrected a statement made by Mr. Jehassi stating there were currently about 100 shops doing wet cleaning in the United States. There are approximately 36,000 dry cleaners in the United States. Probably 95 percent of those dry cleaners do a percentage of wet cleaning as part of their daily functions, because there are garments that require wet cleaning in addition to or instead of dry cleaning. Perhaps what Mr. Jehassi meant to say was that there are doing wet cleaning exclusively.

Mr. Jehassi clarified that he was referring to machine wet cleaning.

Mr. Seitz responded that there are different kinds of wet cleaning machines. Domestic washing machines are machines. Wet cleaning is not new to the dry cleaning industry.

Paula Smith from the Indiana Department of Environmental Management questioned Mr. Jehassi about the Small Business Administration (SBA) workshops being held concerning dry cleaning. She asked if the states were involved with these workshops.

Mr. Jehassi said that a number of the state programs have worked with the SBA small business development centers. Currently, EPA is simply designing the program, and have not yet decided what states will host the workshops. It depends on our funding.

Kay Villa of the American Textile Manufacturers Institute (ATMI) asked Dr. Breen to clarify an earlier comment. Near the end of your presentation he made a comment about finding environmentally-friendly cleaning systems. Alternative cleaning methods may require different techniques to produce textiles and these techniques may not be the most environmentally friendly way.

Dr. Breen responded that the point he was making was that rather than thinking of dry cleaning as an isolated piece of a process, it really should be thought of as part of an industrial ecological web. Those pieces of the puzzle are starting to come together and that sometimes when you look at those interconnections, the whole is greater than the sum of the parts in terms of the gains you can make.

Ms. Villa stressed that even though the textile industry may come out with fabric that can be cleaned using alternative processes that does not necessarily mean what we have done upstream in terms of the manufacturing of the fiber will necessarily be environmentally friendly.

Dr. Breen responded that Ms. Villa was correct and that those parts of the process need to be factored in to discussions about the environmental impact of apparel care.

Jodie Siegel of the University of Massachusetts - Lowell added that it is really important to look at everything in the entire life cycle of the textile and not just the cleaning because otherwise problems are created upstream.

Apparel Care and the Environment

Alternative Technologies and Labeling

Summary of Discussion

Session I (Continued)

Jack Belusci of Global Technologies asked Mr. Jehassi what type of financial incentives were in place to help small cleaning establishments jump to the new technology. Global technology is working on carbon dioxide. Dry cleaners are very concerned about the financial bottom line and even though there are initiatives for new technology there doesn't seem to be a foundation either on the state or federal level for the tax incentives for additional labor that may be coming from wet cleaning or additional capital investments.

Mr. Jehassi said he was not aware of any federal programs that provide funding to help cleaners move over to safer technology. The state of California does have a program in place. It would be a good idea to engage the Small Business Administration to try to create that type of program.

Doug Kelly of Boewe-Permac added that the state of Minnesota is offering 3 or 4 percent loans for environmentally friendly projects for new business.

Ms. Smith said that Indiana has a $200,000 available in challenge grants for states. Dry cleaners are included in that. Two applications came in this year for wet cleaning. One is the converting of the transfer machine to a wet cleaning machine. Funds are not available for equipment but funding for the education to run it and the training needed is available.

Eric Frumin of UNITE commented that it's good to know that in some places around the country the industry is looked at in realistic terms with regard to its ability to handle this transition but that in some places the sympathy just isn't there. Right now the industry is getting very little help. It really isn't getting any attention in most places where it really needs it.

Mr. Weinberg agreed that financial support for the transition to wet cleaning was a vital topic. He urged EPA to help facilitate some stakeholder process and hoped the wet cleaning partnership would be willing to participate as well. EPA should work with states or other agencies that have financial support programs and help them configure those programs so they can be of specific assistance to this industry.

Dr. Riggs expressed his support for what Ms. Villa and Ms. Siegel said with regard to the need to look at the upstream aspects, but believes the aspect of final disposal should also be looked at. Once clothing has served it's useful life span in the hands of the consumer, how difficult is it to dispose of at that point. Looking at the chemistry from a very simplistic view, the more resistent the fibers and dyes are to damage from these various cleaning processes the more difficult they are going to be to dispose of at the end of the garments life.

Eric Frumin commented that within the European Community the green labeling issue provokes some discussion about the environmental hazards from fibers all the way through to disposal that incorporated some attention to working conditions in the different sectors of the industry.

Apparel Care and the Environment

Alternative Technologies and Labeling

Summary of Discussion

Session I (Conntinued)

Dr. Kruessman built on Mr. Frumin's comment saying that eco labeling for textiles, at least in Europe is at a point where some important issues have been discussed. A lot of these issues, especially in terms of the life cycle of a textile, are very difficult to resolve.

Ms. Villa of ATMI was involved in developing a U.S. position policy statement on these eco standards. It's more of a trade issue than a true technical issue. These methods were developed without any testing to validate them. Don't look at them for any specific details to really clearly differentiate what is going on here.

Mr.Frumin clarified his comment, saying that Europeans have a very different perspective on what they would claim as a life cycle analysis. There are a lot of other technical difficulties in the way they describe what happens to the effluent downstream. They have a totally different method of water treatment, so it's really trying to compare apples and oranges.

Ms.Siegel attempted to sum up the comments, saying Eric is talking about the European care label and not the eco label. The Europeans are further ahead of us on developing care labeling for wet cleaning.

David Porter of Garment Care, Inc. commented that his main competitors are customers that clean their own clothes. He urged participants to keep in mind the economic ramifications of whatever environmental technologies come to the forefront.

Jenni Cho of the Korean Youth and Community Center in Los Angeles asked if EPA could possibly work with either Korean community groups or the Korean Dry Cleaning Associations.

Mr. Jehassi responded that EPA does work with the Korean Dry Cleaners Associations and would welcome any participation of any additional organizations.

Mr. Weinberg commented that the CTSA was supposed to be out in 1994. Since then, in terms of the technical issues addressed in Phase I, there has been little new research or development. The delay, on the part of the EPA, in publishing it has contributed to conflict between partners. Clearly there has been an area of on-going contention about just how toxic is perc? Is it not toxic? Is it a threat? Is it a risk? How do you characterize the risk? That's always been a division. There is a general agreement that there is an environmental and health concern but beyond that, the characterization has always been a matter of some disagreement. The inability, up to now, of the EPA to speak on this question has contributed to tension between participants that can be avoided once we get that behind us.

Dr. Breen responded saying the decision had been made to do an integrated Phase I and Phase II. Both should be out in 1997. There is a formal peer review process that the agency goes through where a particular panel of individuals are identified to serve as peer reviewers. The input for names of

Summary of Discussion
Session I (Continued)

people to serve on the panel are solicited by individuals who may well serve as stakeholders. The process where the materials are shared with all of the stakeholders, will not happen until after the peer review process is completed. The current plan is to complete phase I and phase II together. Phase II is almost completed, and both phases are pretty close to being ready to go.

Mr. Jehassi formally ended discussion.